The burden of occupational illnesses and injuries in the developing world is now enormous. Local experts in occupational health and safety are needed to address the growing worker and environmental health problems brought about by global industrial expansion, but such expertise is lacking. The author describes a 15-week, online, instructor-led course, Principles of Environmental and Occupational Health, that was offered to international students over two semesters. She suggests the needs that must be determined and recommends collaborative development of a real-time, online curriculum to enhance the training of professionals in occupational and environmental health. Key words: distance education; distance-based learning; occupational health training.

To prevent the elements of globalization from wreaking havoc on human capital and the environment, worker health and safety as well as environmental protections must be an integral part of policy related to international trade, implementation of new technology, and the structure of local economies. These safeguards are best elaborated by local experts in occupational and environmental health who have experience with, and sensitivity to, local needs. Indeed, the World Health Organization Collaborating Centers in Occupational Health have established a task force for training of occupational health and safety personnel. The goal is to “ensure harmonized contents of various curricula in occupational health and safety, the full utilization of programmes and materials already available and the sufficient numbers of trained experts in the field.”

A number of collaborative training programs exist in occupational health. These models and their advantages and disadvantages are shown in Table 1. The goal of this paper is to describe an Internet-based, real-time, environmental/occupational health course that was offered to international students and to suggest the issues that must be addressed in enhancing training of occupational health professionals.

**PRINCIPLES OF ENVIRONMENTAL HEALTH ONLINE**

In two consecutive fall semesters (15 weeks, August through December, 2002 and 2003), a real-time Internet course entitled “Principles of Environmental Health” was provided to 14 international students. This course was originally developed for public health students at a school of public health in the United States. Through an agreement with University administration, international students were registered in the course for continuing education at no charge, working alongside U.S. students taking the same course for (paid) university credit toward the Master of Public Health degree. The World Health Organization’s Occupational Health Collaborating Centers network helped with recruitment of students. Students were e-mailed an invitation to participate that included a description of the course goals and content, associated computer issues (hardware and software needs and expectations for online activity), information about instructors, and an agreement that they were required to e-mail back if they chose to participate in the course. A textbook was purchased and shipped to each student, courtesy of the WHO.

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**Key words:** distance education; distance-based learning; occupational health training.
TABLE 1. Training Options for International Students in Occupational and Environmental Health

<table>
<thead>
<tr>
<th>Type of Program</th>
<th>Advantages</th>
<th>Barriers</th>
</tr>
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<tbody>
<tr>
<td>Students brought abroad to long-term training program</td>
<td>• Training is intensive, multidimensional&lt;br&gt;• Opportunity to select from many course offerings&lt;br&gt;• Multiple mentors available&lt;br&gt;• Opportunity to observe practical applications of training in a different setting/culture</td>
<td>• Cost&lt;br&gt;• Limited number of students trained&lt;br&gt;• Content may be irrelevant in home country&lt;br&gt;• Student has to leave home for prolonged period&lt;br&gt;• Job in home country may disappear</td>
</tr>
<tr>
<td>Students brought to a center for mini-course</td>
<td>• Relatively small time commitment&lt;br&gt;• Concentrated learning&lt;br&gt;• Ability to interact with students and experts from multiple countries</td>
<td>• Cost&lt;br&gt;• Accessibility&lt;br&gt;• May not be tailored to needs of all students</td>
</tr>
<tr>
<td>Mini-courses taught in home country</td>
<td>• Greater accessibility to students&lt;br&gt;• Concentrated learning</td>
<td>• Cost of instructor travel&lt;br&gt;• Generally short duration&lt;br&gt;• Limited breadth/availability of courses</td>
</tr>
<tr>
<td>On-line teaching</td>
<td>• Can reach large number of students&lt;br&gt;• May increase information technology infrastructure&lt;br&gt;• Can facilitate interaction of students and faculty from many countries&lt;br&gt;• Some pedagogic strategies are better on the Internet</td>
<td>• Connectivity&lt;br&gt;• Cost of establishing infrastructure&lt;br&gt;• Cost of downloading materials&lt;br&gt;• Computer literacy&lt;br&gt;• Comfort with pedagogy on the part of students and faculty&lt;br&gt;• Not in native language</td>
</tr>
</tbody>
</table>

COURSE DESCRIPTION

The overall goal of the course is to improve familiarity with the range of disciplines encompassed by environmental and occupational health and to help students gain an appreciation of the approaches by which professionals identify, analyze, and solve occupational and environmental health problems. Student competencies include:

- Conducting a qualitative and a quantitative risk assessment
- Utilizing internet-based resources
- Investigating a specific environmental health issue
- Discussing current events related to environment and the workplace
- Interacting with (other) professionals in the field
- Constructing and posting a debate position on a current topic (year one: precautionary principle; year two: use of DDT for malaria control)
- Answering questions related to air quality, water quality, food quality and sustainable agriculture, workplace outbreak investigations, illness and injury prevention, workplace hazards, toxicology, urban planning, and global environmental/occupational issues

The course was developed within the Blackboard software framework (www.blackboard.com) and utilized the textbook, Basic Environmental Health by Yassi et al. to organize the subject matter into 14 week-long sections. The first week entailed exercises designed to help students gain facility with the software. Each Friday, the assignment for the following week was posted. This could include a chapter in the text, additional readings (either transmitted to students via a “digital drop box” or directing/linking them to existing Web sites), slide-show presentations, and interactive exercises (for example, students were posed case scenarios and had to choose a study design to address the research question; after they made a choice, a description of the instructor’s choice would pop up on the screen). Some weeks there were multiple-choice quizzes, and other weeks the students had to complete an assignment and upload it to the site for the instructor’s evaluation. One such assignment entailed filling in a chart of energy sources and describing the advantages and disadvantages of each. Students also had to take an occupational history from an acquaintance utilizing a form designed for that purpose. In a two-week assignment, students were divided into small groups to construct a debate position. The instructor could view the work of each group and its participants, but other students could only view the final position when it was posted to a Web site at a specified hour; each group was given one week to assemble a response to the opposing view. A “discussion board” divided into weekly topics allowed students and instructors to post questions and comments related to the current week’s subject matter. There was also a section on “current events,” one to post exam feedback, and one to discuss technical questions related to software problems or to clarify assignments.

Students were expected to log on to the course each week to pick up the new assignment and to complete the work by a specified date (1–3 weeks later). The
course was designed so that a work product was submitted weekly; failure to submit resulted in an e-mail query to the student by the instructor or teaching assistant. Students could do work or post questions at any hour.

Students

Fourteen students from Senegal, Ghana, South Africa, Kenya, Turkey, Poland, Vietnam, Philippines, Thailand, and Costa Rica enrolled in the course, along with approximately 55 U.S. students. All of them had at least a bachelor’s degree from a university or college. Half were physicians. They worked in clinical practice, at universities, and in ministries of health. The U.S. students were a combination of physicians, nurses, general public health students, and medical students getting additional training in public health.

Student Performance

In 2002, ten students were enrolled in the course. Five students completed the entire course; four completed approximately half of the assignments; one student dropped out after two weeks. In 2003, four students enrolled. One completed the entire course. One completed two thirds of the course, but dropped out due to developing malaria, coincidentally during the student debate on the use of DDT. The other two students dropped out within two weeks of the beginning. Students who completed the course were indistinguishable from the best U.S. students in terms of quality of work and activity on the Web site. The content of the discussion included more international issues that were raised by the international students compared with course sections that included U.S. students only.

Student Evaluation of the Course

A questionnaire was e-mailed to the international students to ask about connectivity, where they had accessed the course, the expense to them, the optimal length of time they would recommend for the course, and technical problems, with an open-ended question about what they thought of the course. All students had connected through telephone lines, and several had had intermittent trouble establishing or maintaining the connection. A few students did not like working online and printed most of their reading materials, incurring a greater expense than they had anticipated. All students had worked at the office, but some had worked at home, as well. Those who dropped out of the course stated that the time commitment was too great and the course too long; those remaining in the course answered that 15 weeks was an appropriate and acceptable amount of time. Two students had frequent technical difficulties for which they requested help; the same students had obvious difficulties with the English language, which may account for our difficulty in facilitating their work. Several students requested more courses in this format, the opportunity to complete an online degree, and a mentored field practice activity.

Issues for the Instructors

This course was developed as part of the core curriculum for public health students at a U.S. university. Because of the breadth of material covered, the course was “team-taught” by two university faculty members, one an exposure expert (water quality), and one an occupational health physician. A teaching assistant was assigned to interact with students, as well. The course was taught and changed two times before it was offered to international students. The preparation it took to organize and put the course online was similar to the requirement in classroom teaching. One instructor and/or the teaching assistant accessed the course at least twice per day, seven days per week. Instructor contact time was at least ten hours per week. Having ten additional students increased only instructor time for grading written assignments; quizzes were automatically graded and placed in a spreadsheet by the software, and the debate incorporated international students with no additional work on the part of the instructor. It is difficult to assess time spent answering the international students’ questions, beyond the time taken for U.S. students.

DISCUSSION

The online course described here was taught to a mixture of international students, located in the United States and abroad. Half of the students who enrolled completed the course. Because the instructors were already teaching the course to U.S. students, no additional costs were incurred by the university, aside from the extra time it took the instructor to grade student assignments. The value of this sort of a course is obvious: Students can access the course from all over the world, interacting with students from markedly different cultures. The variation of experiences of the student body is bound to broaden the perspectives of other students. Computer hardware and connectivity are much less expensive than other means of training international students (see Table 1). Students can work at their convenience, during or after work hours. They do not need to leave home, and they are able to keep their employment. Once the online course is developed, enhancements are no more time-consuming for the instructor than they would be for a classroom course. The ability to reach large numbers of professionals is limited only by ability to advertise, by Internet-connected computer availability, and by a salary for the instructor. A series of courses could be developed to address the needs of professionals who require addi-
tional training to work in the disciplines related to occupational and environmental health. Local resources need to be integrated into the curriculum, which would best happen with the input of local professionals. Limitations include limited computer availability, poor connectivity to the Internet, lack of computer experience, difficulty with English, costs of the textbook, printing, and telephone line, no face-to-face interaction between instructors and students, absence of locally relevant resources in the curriculum, and a potentially high dropout rate.

RECOMMENDATIONS

A small body of published literature describes the need for training of professionals in the areas of occupational and environmental health and hygiene in China, India, South Korea, Malaysia, Taiwan, Mexico, Philippines, Poland, Saudi Arabia, Egypt, and Brazil. A formal needs assessment should be conducted to answer the following questions:

1. Course development
   What are the local efforts and local needs in occupational health training in industrializing countries?
   How can courses be developed to support local efforts, e.g., add to an existing public health school curriculum? Become part of continuing education efforts?
   How will courses be developed? By whom? Who will teach them?
   How long should courses be developed? By whom? Who will teach them?
   How long should an entire program be?
   What existing materials should be used in such a course?15

2. Course content
   What courses should be developed?
   How can relevance and quality be assured?
   Should primary research be part of the curriculum?
   If so, how should it be mentored?
   How can “hands on” experiences be injected into this scheme—e.g., could a “virtual” walk-through of a workplace substitute for a real walk-through?

3. Accreditation/Administration
   Should the program grant continuing education credits or a degree?
   Who will accredit it?
   Should the effort be multinational? If so, how will agreements be made regarding standards for accreditation?
   Who will administer such a program?

4. Access
   What language(s) should be used?
   How may hardware be obtained and connectivity improved?
   How can students gain access to the website? At work? At home?
   What technical support should be offered?

5. Student Issues
   How should students be recruited and selected—what should their qualifications be?
   How can their commitment to completing the work be promoted?
   How many courses should students be expected to take at one time?
   Should students go through a series of courses in lock-step (as a group) or individually?
   Who will pay—students? Governmental or non-governmental organizations?

Partnerships between industrializing and industrialized countries could serve to fill the gaps in occupational health and safety training, educating professionals in the areas of industrial hygiene, exposure and risk assessment, epidemiology, surveillance, occupational and environmental health services, policymaking, and research methodology. Local expertise would be nurtured to address local problems. In addition, cross-national efforts could foster collaborative research, as well as harmonization of standards in the workplace and the general environment. Distance-based educational programs are ideally suited to reach wide student audiences at low cost, and could address the need for occupational safety and health training, internationally.

References